

Systematic Review of Health Organization Guidelines Following the AMSSM 2019 Youth Early Sport Specialization Summit

AMSSM Collaborative Research Network Youth Early Sport Specialization Summit*

Context: Youth sport specialization may place young athletes at increased risk for negative impacts to their physical and/or psychological health. In response to these health concerns, several health organizations have created guidelines and position statements to guide parents and practitioners toward best practices for management of the young athlete.

Objective: To systematically review and synthesize current organizations' recommendations and guidelines regarding youth sport specialization.

Data Sources: English-language articles from January 1, 2000, to December 31, 2018, in the NCBI Pubmed, Embase, Cochrane, CINAHL, and SPORTDiscus databases.

Study Selection: Articles that reported on recommendations or interventions by health organizations or health representatives of sports organizations. A total of 56 articles were assessed, with 11 meeting inclusion eligibility criteria.

Study Design: Systematic review.

Level of Evidence: Level 4.

Data Extraction: Two investigators independently identified all recommendations within the results that fit within a 15-item framework encompassing 4 domains: Psychological Development/Approach, Physical Development/Load, Facilities and Resources, and Timing and Monitoring of Specialization.

Results: Recommendations across organizations were primarily clustered in the Physical Development/Load (43%), Facilities and Resources (48%), and Sport Specialization (55%) domains. In contrast, the Psychological Development/Approach domain had fewer recommendations (20%). The most common recommendations endorsed concepts: "Monitor athlete well-being," "Youth athletes need access to well-trained, quality coaches," "Multi-sport participation," "Limit early organized participation and/or training," and "Parents require awareness of training, coaching, and best practices." The level of evidence provided to support a given recommendation varied significantly. The level of detail and the consistency of terms used throughout the results were typically low. Recommendations were frequently made without reference to potential outcome measures or specific strategies that could be used for practical implementation in the community.

Conclusion: There was broad representation of different aspects of specialization but limited consistency between health organization guidelines. Adopting a framework for recommendations as used in this review could assist organizations in structuring future recommendations that are specific, measurable, and framed in a manner that will promote action in the youth sport community.

Keywords: sport specialization; recommendations; athlete development

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This review was conducted in conjunction with the American Medical Society for Sports Medicine (AMSSM) Collaborative Research Network's 2019 Youth Early Sport Specialization Summit. The goals of the Youth Early Sport Specialization Summit were to (1) conduct and present a rigorous review of the current scientific knowledge and (2) develop a "research roadmap" to drive future research efforts based on existing evidence in the field of youth athlete training and development. Systematic reviews on the topics of the impact of youth sport specialization on career- and task-specific athletic performance⁹ as well as on health outcomes are also available or in development. These reviews serve as the foundation for a scientific consensus statement aimed at addressing the research gaps identified in these reviews.

Specialization is often defined as "intense training in a single sport at the exclusion of others" and is commonly viewed as a mechanism for maximizing athletic performance potential. Sport specialization is increasingly common during childhood and adolescence and has received significant recent attention in the sports medicine community because of concerns for potential adverse health outcomes. The benefits and risks of youth sport specialization are not completely understood. However, sport specialization is typically associated with high volumes of training and competition year-round, and these behaviors may place athletes during times of growth and development at increased risk for lower extremity injuries,^{15,19} particularly overuse injuries.²⁰ In addition to injuries, psychological well-being is a concern for youth athletes who specialize, including risk for burnout and discontinuation of long-term sports participation.^{5,12,13}

The sports medicine community, sport governing bodies, and others who provide care to youth athletes have responded to the rise in sports specialization and associated health concerns by writing guidelines and position statements. Various professional organizations have released recommendations regarding aspects of participation at different stages of development, including training and competition loads, specialization, and other factors. These recommendations have largely summarized the available published research, and all have included expert opinion to address the current knowledge gaps. To date, neither has a review of common elements and comparison of current recommendations been completed on the topic of youth sports participation nor have guidelines within a given sport been compared.

A comprehensive assessment and synthesis of youth sport specialization recommendations are critical to identify areas in need of further research and develop actionable guidelines and interventions. Our approach was composed of 2 different review strategies: (1) a systematic review of the available published medical literature regarding recommendations and guidelines on sport specialization and (2) a sport-specific review of applied recommendations identified in the systematic review from an international set of sport organizations and governing bodies on 4 international sports. This article is the

result of strategy 1 and summarizes findings from the systematic review of available published medical literature on recommendations and guidelines for sport specialization. The review of recommendations from an international set of organizations and governing bodies (strategy 2) can be found elsewhere.²²

METHODS

Defining Sport Specialization

Despite growing interest within the sports community regarding youth sport specialization and expanded calls for increased research and evidence-based guidelines on the topic, there is no current consensus on a singular definition of sport specialization. The concept of sport specialization has been attributed to Wiersma²⁴ and defined as early participation in a singular sport at high intensity of training and competition. Côté et al⁴ classified sport specialization as a focus on a singular sport through many hours of deliberate practice with the goal of improving sports skill and performance. Other definitions have been proposed, typically with different levels of emphasis on the timing of specialization during maturation or on the intensity of training and competition within the specialized sport; however, each definition typically shares a common element of focused participation in a single sport. It is likely that there is no fixed universal threshold that defines specialization within a single sport; rather, early sport specialization likely represents a continuum of volume and intensity of training and competition within a single sport. Moreover, the effect of volume and intensity is likely further influenced by the level of maturation of the athlete and the duration for which the athlete has been specialized. These aspects need to be considered when investigating the effects of early specialization and when crafting recommendations either broadly or within a particular sport. For the purposes of this review, we considered all recommendations and guidelines addressing sports specialization, irrespective of definitions of sport specialization used by the authors.

Search Parameters

Published articles pertaining to sport specialization were identified with a predetermined search strategy. Using the NCBI PubMed, Embase, Cochrane, CINAHL, and SPORTDiscus databases, peer-reviewed, English-language articles from January 1, 2000, to December 31, 2018, were identified using keywords (Appendix Table A1, available in the online version of this article). The search excluded animal-based studies and was not limited by age parameters.

Inclusion/Exclusion Criteria

Articles in full-text form were included that reported on recommendations or interventions by health organizations or health representatives of sports organizations. Articles that did not provide recommendations or practice guidelines were excluded.

Data Abstraction and Analysis

The identified articles were reviewed independently by 2 authors, and disagreements were adjudicated by a third author. Titles and abstracts of all search results were screened for potential relevance. Any citation that was deemed potentially relevant was retrieved in full text and assessed in accordance with the above criteria. All included items were used to generate a summary of existing guidance on youth sport specialization.

Data abstracted from the identified sources included type of study and recommendations. Recommendations were sorted into 15 defined categories based on common elements identified during the review process. For the purposes of organization and discussion, these 15 categories were grouped into 4 thematic domains.

Psychological Development/Approach

This theme revolves around holistic athlete development. Items include aspects regarding psychological well-being, enjoyment of sport and physical activity, and athlete safety.

1. *Talent identification over talent selection:* Talent can be developed over time and there is no need to exclude some athletes simply because they are not as advanced in skill as others.
2. *Instill passion for physical activity and sport:* Promotion of lifelong participation in sport to ensure athletes do not discontinue physical activity and do remain healthy over their lifetimes.
3. *Create a broad definition of sport success:* Avoid focus on winning and competing and emphasize skill development and individual milestones.
4. *Promote safety, health, and respect for rules:* Teach respect for other players, the rules, and the sport in general.
5. *Promote psychological development and well-being:* Develop qualities such as robustness, resilience, and personal excellence to ensure that athletes maintain balance in their personal lives, avoid burnout, and stay engaged in physical activity.

Physical Development/Load

This theme revolves around early skill development and volume of training and competition.

6. *Account for differences in maturation:* Despite being of similar ages, children may differ with regard to overall physical, mental, and emotional development. Training approaches and loads should take these factors into account.
7. *Fundamentals should be emphasized early:* Young athletes should learn sport-specific movements, the rules of game play, and how to interact with different play environments.
8. *Integrate conditioning and injury prevention programs:* In addition to practices and competitions, training regimens should include formal strength and conditioning as well as injury prevention programs.

9. *Limit early organized participation and/or training:* Youth and adolescent athletes should follow training volume recommendations. Athletes should have adequate periods of rest during training and competition, as well as breaks from play for a given sport during the year.

Facilities and Resources

This theme revolves around access to facilities and coaches.

10. *Parents require awareness of training, coaching, and best practices:* Parent education is an important component for ensuring the well-being of children and identifying physical and psychological sequelae, such as burnout.
11. *Youth athletes need access to well-trained, quality coaches:* Excellent coaching can maximize athlete development and ensure that volume and rest recommendations are met.
12. *Access to high-quality facilities:* Excellent facilities can maximize the benefits from training and coaching and provide a safe environment for training and competition.

Timing and Monitoring of Specialization

This theme revolves around issues that are important to identify early from late specialization and single-sport participation from multisport participation.

13. *Discuss sports goals with the youth athlete:* Identify motivating factors for the athlete and distinguish them from those of adjacent sources such as parents or coaches to determine if specialization is appropriate.
14. *Multisport participation:* Participation in multiple sports during youth and early adolescence is most appropriate.
15. *Monitor athlete well-being:* Parents, coaches, and clinicians should be aware of and monitor for signs of burnout and overtraining, especially in highly specialized athletes.

An article was cited as having a recommendation for a given category if (1) detailed in a “recommendation section” or similar, (2) if the article made a clear and explicit statement on a given category regardless of its section in the article, or (3) if the statement was specifically made in the context of sport specialization. The documents were reviewed for recommendations within these categories independently by 2 authors, and disagreements were adjudicated by a third author.

RESULTS

The database search provided 637 results (Appendix Table A1 available online). After title and abstract screening, 56 underwent full-text screening and 11 sources were included in the final analysis (Figure 1). The articles varied with regard to the overall purpose of each manuscript. Sport specialization was the primary focus in 3 of the 11 articles.^{3,7,10} Two of these 3 articles were statements by the American Academy of Pediatrics (2000⁷ and 2016³). Most articles discussed sport specialization within the context of broader topics such as overuse injuries. The extent to which sport specialization and related issues were

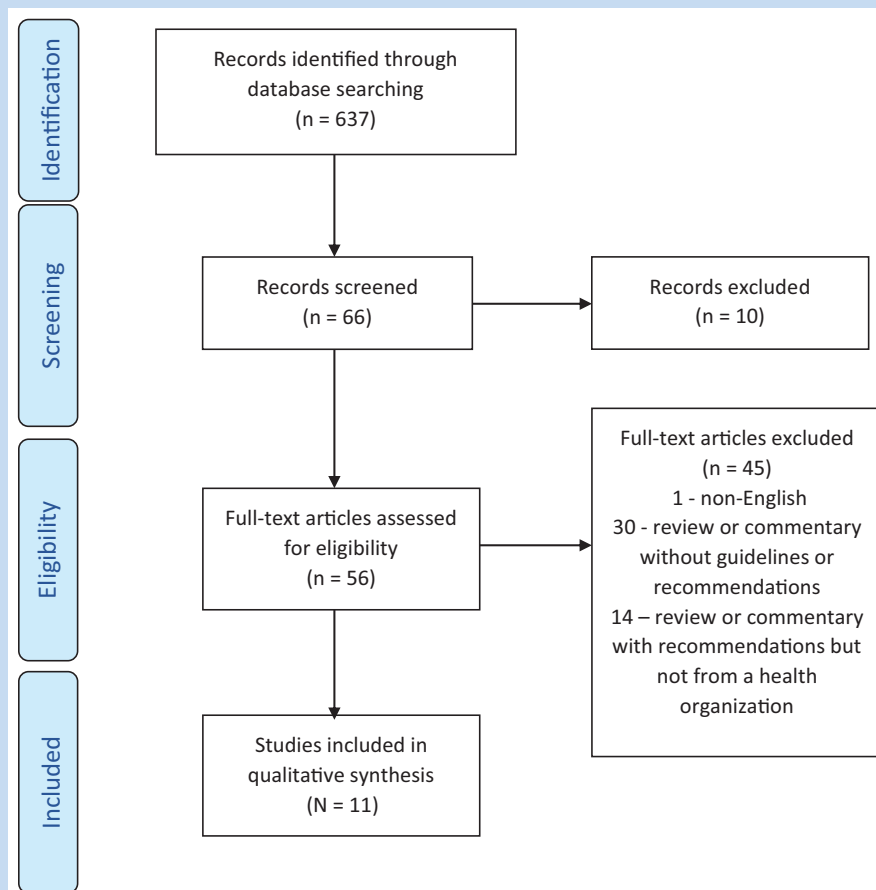


Figure 1. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) systematic review flow diagram.

discussed varied widely, ranging from the 3 statements specifically on the topic of sport specialization to brief statements within others.

Recommendations were primarily clustered in the Physical Development/Load, Facilities and Resources, and Timing and Monitoring of Specialization domains, with 43%, 48%, and 55% of possible recommendations in these domains endorsed across the 11 articles (Table 1). At least 1 category in the thematic domain of Timing and Monitoring of Specialization was represented in 9 of the 11 manuscripts. In contrast, the Psychological Development/Approach domain was noted to have fewer recommendations both in absolute number and percentage of potential endorsements (20%); however, this domain had a higher number of recommendations from articles published in more recent years.

The level of evidence provided to support a given recommendation varied significantly. For example, the International Olympic Committee statement regarding the training of elite child athletes was noted to have made recommendations in several of our described categories; however, the article itself was very brief and did not include references of studies supporting these recommendations.¹⁷

Conversely, the National Strength and Conditioning Association's statement on athlete development provided detailed discussions and references for each of its statement's positions.¹¹ Similarly, many statements provided various levels of discussion or justification for a given position. The AMSSM's statement on overuse injuries and burnout and the National Athletic Trainers' Association statement on pediatric overuse injuries were the only articles noted to have provided Strength of Recommendation Taxonomy (SORT)⁶ categorizations for their recommendations.^{5,23}

The level of detail and the consistency of terms used throughout the results were typically low. One particularly prominent example was regarding the multitude of terms for describing different age groups and maturational statuses in discussing appropriate timing for potential specialization. Multisport participation was encouraged for "younger ages"⁵ and "pediatric athletes"²³ and to delay specialization until "puberty,"³ "adolescence,"⁷ or "adolescence to young adulthood."¹⁷ The terms by growth and development were not well-defined. Similarly, recommendations were frequently made without reference to specific metrics, tools, or resources that would be used for practical implementation in the community.

Table 1. List of included studies

Year	Organization	Focus	Psychological Development/Approach					Physical Development/Load					Facilities/Resources					Timing and Monitoring of Specialization							
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15								
2007 ⁷	AAP ^a	Sport specialization														x				x				x	
2007 ²	AAP ^b	Overtraining/overuse				x								x										x	
2008 ²¹	AAP, AOS, ACSM, AMSSM, AOSSM, AOASM	Adolescent athlete												x											
2008 ¹⁷	IOC	Adolescent athlete						x																	x
2011 ²³	NATA	Overtraining/overuse, injury prevention													x										x
2013 ¹⁶	ACSM, ECSS	Overtraining/overuse																							
2014 ⁵	AMSSM	Burnout								x															
2015 ¹	IOC	Athlete development				x								x											x
2016 ³	AAP ^c	Sport specialization		x																					x
2016 ¹¹	NCSA	Athlete development		x																					x
2016 ¹⁰	AOSSM	Sport specialization													x										x

AAPF, American Association of Family Practitioners; AAP, American Association of Pediatrics; AADS, American Association of Orthopedic Surgeons; ACSM, American College of Sports Medicine; AMSSM, American Medical Society for Sports Medicine; AOASM, American Osteopathic Academy of Sports Medicine; AOSSM, American Orthopaedic Society for Sports Medicine; ECSS, European College of Sport Science; IOC, International Olympic Committee; NATA, National Athletic Trainers' Association; NCSA, National Strength and Conditional Association.

^aReaffirmed by the AAP in February 2015.

^bReaffirmed by the AAP in September 2014.

^cReplaces statement by the AAP from 2000.

These included aspects such as appropriate physical loads in different age or maturational groups, viable tools to monitor for burnout, and educational resources for coaches, parents, and other key stakeholders in the community.

DISCUSSION

By evaluating guidelines across organizations, we were able to construct a framework to evaluate recommendations on youth sport specialization consisting of 15 categories organized into 4 domains. Recommendations by organizations within each domain are summarized.

Psychological Development/Approach

Despite several results which acknowledged that youth sport specialization may contribute to burnout, discontinuation of sport participation, and altered psychosocial well-being, we noted few clear recommendations within this domain. Most recommendations were clustered in more recent publications. Our findings may reflect the growing body of literature in this area combined with increasing recognition of the potential effects of sports specialization on an athlete's psychological health. A particularly instructive example is the American Academy of Pediatrics organization statements from 2000 and 2016. The earlier statement explicitly noted that while there have been anecdotal reports suggestive of athlete burnout from stress, missed social and educational opportunities, and family life disruption, scant data were available on this topic.⁷ In contrast, the updated statement from 2016 included several references pointing to a potential increased risk of burnout, anxiety, depression, social isolation, attrition, and other psychosocial concerns and accordingly included more recommendations within this domain.³

Despite this change in the available literature, the updated statement by the American Academy of Pediatrics in 2016 addressed only 1 of the 5 recommendations that we constructed within this domain. Few of the articles included in this review, including recent publications, proposed recommendations on a comprehensive approach to address psychological aspects in youth sports. This observation may be explained by a number of factors. Research in this area has been growing, and organizations may be hesitant to offer recommendations based on limited available evidence. Organizations may also choose to focus on different domains that diverge from topics of psychology. Furthermore, it is possible that the 15-item framework used for the purpose of this review may not have been able to adequately capture a given organization's position in this topic area.

Physical Development/Load

A majority of the guidelines addressed recommendations pertaining to physical development/load. Specific statements included the need to monitor training loads that account for the maturation level of the athlete and the need to include injury

prevention strategies. However, our review did not identify clear consensus on best practice to monitor athletes, including how to best quantify participation by different ages or maturation levels. Specific strategies that have been proposed in the literature are to limit the number of hours of sport-specific training to less than the athlete's age in years⁸ or to restrict training load to less than 16 hours per week.²⁰ These general recommendations lack specificity and supporting evidence to apply across sports, reflecting our findings in lack of specificity of recommendations by health organization identified in this review. Similarly, there was a lack of specificity regarding who should be responsible for implementing the monitoring strategy, such as a coach, parent, or sports organization. Additionally, sports-specific activity considerations were not fully described. For example, guidelines have been proposed for baseball around pitch counts and limited throwing (eg, not playing field positions of both a pitcher and a catcher) but not described for batting, running, and fielding.¹⁴

Periodization of training, including the periods of planned rest recovery and exercise variety, are considerations underlying training volume, intensity, and cumulative musculoskeletal load. Recommendations supported the concept that adequate time should be provided for rest and recovery to minimize injury risk related to overuse and decrease burnout; however, there was a lack of specificity regarding best practices. One recommendation common to 3 health organization guidelines was that sport-specific participation should be limited to approximately 8 months or less per year with 2 to 3 successive months off.^{2,3,11} More limited proposals for time off during weekly training were proposed, limited to the recommendation of 1 to 2 days of recovery per week.² The guidelines did not specify whether these principles should be applied across all ages and stages of maturation. This relative lack of specificity may limit applying these recommendations for a given youth athlete by a health professional, coach, or parent.

Facilities and Resources

Youth athletes, particularly those undergoing intensive training, were commonly recommended to be closely monitored by parents, coaches, and/or medical providers for signs and symptoms of overtraining and burnout. The most commonly offered remedy was to provide education that allows coaches, parents, and athletes to adhere to training load and to monitor for the development of symptoms to suggest burnout. Similar to recommendations on appropriate physical development and training loads, there was a lack of specificity regarding the educational content, the target audience, and program implementation that would best affect the athletes' overall health. While 1 joint organization statement provided an in-depth statement regarding overtraining and included a detailed discussion of various monitoring and assessment techniques,¹⁶ there were no clear recommendations on how to implement tests for community use, particularly in the context of the youth athlete.

Timing and Monitoring of Specialization

A majority of the guidelines addressed recommendations in this domain, particularly with regard to encouraging multisport participation with delayed specialization and the need to monitor the well-being of the specialized athlete. Organizations' consensus was that early intensive training, seen during youth sport specialization, may contribute to negative health outcomes, including an increased risk of injury and sport dropout/burnout without necessarily providing a substantial benefit to future success for elite athletes. Furthermore, recommendations were to delay intensive, single-sport participation until approximately adolescence. Prior to this transition, sports training in the youth athlete should focus on the acquisition of fundamental sport-specific movements and techniques with a goal to improve overall neuromuscular development, strength, and conditioning.

Similar to other recommendations, there was a lack of specificity on the topic of specialization. For example, the recommendations for sport specialization utilized a variety of general terms without consistently providing definitions for development (eg, "puberty" or "adolescence"), which may make implementation of these recommendations challenging. Maturation includes physical and psychosocial dimensions that may occur along different timeframes. Given the variability in puberty by onset and duration along with physical and psychosocial maturation considerations, it is advisable to use more specific definitions, terms, or instruments.

Recommendations should be specific: Guidelines should attempt to provide specific information regarding appropriate levels of participation. Chief among these were terms related to timing of multisport versus potential specialization. Terms such as "puberty" and "adolescence" may be open to a wide range of interpretation in the community and should be defined. Recommendations for training loads and specialization may be best in the context of specific ages as opposed to maturation. We recognize that an individual athlete will have variable levels of mental, emotional, and physical maturation at a given age; however, the advantage of using age or other easily defined and measurable metrics may be in the ability for information to be translated to the community level and implemented. Maturation levels can then be used to contextualize decisions on training load and specialization within specific age ranges as some of the reviewed guidelines noted. Recommendations regarding education of coaches and parents were similarly somewhat ill-defined and there was a lack of resources provided in the recommendations for implementing these recommendations. Regardless of the metrics or terms that are employed, specificity and consistency with an eye toward making a given recommendation actionable in the field is important.

Recommendations should be quantified: Similar to the need for specificity in terms, recommendations typically need

to be measurable in order to allow for translation to the community. For example, recommendations relating to aspects such as training loads and rest periods from a sport, particularly within the context of different maturation levels, generally did not provide specific details. This lack of specific guidance may be a barrier that inhibits the ability of physicians, coaches, parents, and athletes in the community to enact appropriate sports participation programs. Athlete development models from a given sport's governing body may be referenced for these recommendations; however, we acknowledge that such guidance may not be available for all sports, or may be contextualized as needed to fit the health organization's position. Recommendations related to monitoring athletes' well-being for signs of burnout or overtraining similarly had a lack of specificity as to metrics to be used or actions to be employed.

Recommendations should be comprehensive:

Recommendations should cover the range of youth athletes and be inclusive of all aspects relevant to the issue of specialization. In particular, we found a paucity of recommendations in the domain of Psychological Development/Approach. While this may be due in part to the level of literature available in this domain, it is imperative to take a holistic approach to the athlete to encompass physical, psychological, social, and other aspects relevant to the issue of specialization. Focusing recommendations narrowly on the question of when to specialize likely misses several aspects of health and long-term wellness that need to be considered in youth athletes.

Recommendations should be evidence based: A significant goal for guidelines regarding athlete development and sport specialization is to improve the strength of evidence underlying a given recommendation. It is likely that a significant amount of the generalities of the included recommendations stem from the fact that there is currently still a relatively small body of research in the area of sport specialization. The evidence that is available is commonly in the form of cross-sectional and observational cohort studies, with a relative lack of prospective or interventional studies providing support to the listed recommendations. As such, the recommendations are leavened by a considerable amount of expert opinion. This should not be taken to mean that health organizations should not provide guidance on these topics without solid underlying research, but rather that recommendations should come with a clear statement as to the level of supporting evidence (eg, SORT or other strength of evidence rating scale).

Limitations

The review has some limitations. This methodology has not been validated to improve health outcomes in youth athletes.

Recommendation categories may have different levels of importance by sport, athlete characteristics, and other contexts.

Applying this framework to organization statements should not be interpreted as limitations of prior work. Some recommendations contained features that are closely related to other categories or domains. The determination of whether an organization statement contained a specific recommendation category within the review framework was a subjective assessment; agreement between authors was used to mitigate this process. Finally, we recognize other reviews and research articles provide valued recommendations on the topic of youth sport specialization but did not meet criteria for inclusion as a health organization.^{4,8,18} Our intent was to capture the positions of health organizations and sports governing bodies,²² but we acknowledge that these are not the sole providers of guidance on the topic of specialization.

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